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## CLINICAL ARTICLE

## Fetal and infant health outcomes among immigrant mothers in Flanders, Belgium

Evy Gillet<sup>a,\*</sup>, Bart Saerens<sup>b</sup>, Guy Martens<sup>c</sup>, Hendrik Cammu<sup>a,c</sup><sup>a</sup> Department of Gynecology, Universitair Ziekenhuis, Vrije Universiteit Brussel, Brussels, Belgium<sup>b</sup> Department of Mechanical Engineering, Katholieke Universiteit Leuven, Heverlee, Belgium<sup>c</sup> Study Centre of Perinatal Epidemiology, Brussels, Belgium

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## ABSTRACT

**Objective:** To compare fetal and infant mortality between immigrant and native-born mothers in Flanders, Belgium. **Methods:** In a population-based study, data from 326 166 neonatal deliveries, collected by the Study Center for Perinatal Epidemiology and the Belgian Civil Birth Registration system between January 2004 and December 2008, were analyzed. Immigrant mothers were defined as women born in any country other than Belgium, and were grouped by country of origin according to the World Bank Atlas definition of low-, middle-, and high-income countries. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated to evaluate the association between immigration and fetal/infant outcome. **Results:** In univariate analysis, fetal and infant mortality rates were significantly higher among immigrants than among native-born mothers (fetal: crude OR, 1.50; 95% CI, 1.29–1.75; infant: crude OR, 1.47; 95% CI, 1.29–1.67). Fetal/infant death rates were highest among mothers originating from low-income countries. In multivariate analysis, however, most differences became non-significant: only the early neonatal death rate remained significantly higher (adjusted OR, 1.30; 95% CI, 1.06–1.60), whereas the fetal death rate appeared lower (adjusted OR, 0.67; 95% CI, 0.57–0.80), among immigrant mothers. **Conclusion:** After adjustment for relevant characteristics, fetal/infant mortality was comparable between immigrant women and native-born women in Flanders.

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## 1. Introduction

Human migration is a global occurrence that influences the health of individuals and populations [1]. Research on migrant health shows that migrants, especially women and children in their first year of life, are a vulnerable group of society who face health challenges that differ from those of native populations [2]. Whether or not immigrant status is a risk factor for adverse fetal and infant health is not clear [3]. The heterogeneity in study design and the different definitions of migrants used complicate any broad generalization concerning study outcomes [4,5].

Some immigrant mothers have been shown to have similar or even better perinatal health outcomes than native-born women, a paradoxical pattern explained by the “healthy migrant effect” (i.e. the selection of very healthy women at migration) [6]. Other studies have revealed that immigrant mothers experience worse pregnancy outcomes compared with native women, showing higher rates of prematurity, lower birth weights, and higher rates of perinatal mortality [7–9]. A systematic review of the pregnancy outcome of migrants in Europe has suggested that immigrants in countries with a strong integration policy (i.e. Netherlands, Denmark, Norway, Sweden, and Belgium) fare better

than those in countries where immigrants are expected to fit into the receiving society without the support of specific policies (i.e. Spain, UK, Italy, France, Germany, and Austria) [9].

Across Europe, sizeable proportions of pregnant women originate from countries with different cultural, ethnic, educational, and socioeconomic background. Flanders, the northern part of the constitutionally federal state of Belgium, is no exception. This region of 13 522 km<sup>2</sup> has a population of approximately 6.2 million with its own language, government, and parliament. The distance to a hospital is not an issue, because Flanders is one of the most urbanized regions in Europe and has 68 fully equipped maternity units, where 99.8% of all births occur. Four of these units are in university hospitals, 15 in hospitals with training facilities, and 49 in community hospitals. The aim of the present study was to determine whether there are increased risks of fetal and infant mortality among immigrant mothers compared with native-born mothers living in this highly affluent region of Belgium.

## 2. Materials and methods

The present population-based study was conducted on data from all births occurring between January 1, 2004 and December 31, 2008, in Flanders, Belgium. Study data were obtained from the Study Center for Perinatal Epidemiology (SPE) and the Belgian Civil Birth Registration (CBR) system. Neither ethical approval nor informed consent was required for the study.

\* Corresponding author at: Department of Gynecology, Universitair Ziekenhuis - Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Jette, Belgium. Tel.: +32 498 52 32 84; fax: +32 2477 65 46.

E-mail address: [evy.gillet@vub.ac.be](mailto:evy.gillet@vub.ac.be) (E. Gillet).

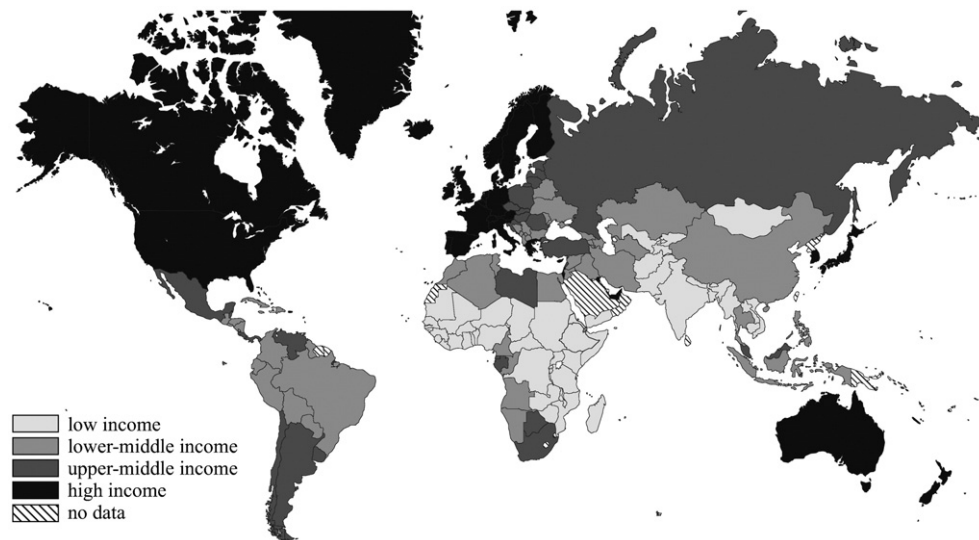


Fig. 1. Map showing countries of origin, shaded according to World Bank ranking, of immigrant mothers who delivered in Flanders.

For newborns weighing 500 g and more in Flanders, a standard perinatal form containing maternal, obstetric, and neonatal items is completed by the maternity unit and sent to the SPE, an independent and regionally funded center. Perinatal data from all maternity units are centrally collected, subjected to an error detection program, checked for accuracy and completeness through feedback with the individual units, and reassessed when needed.

It is a legal requirement to register live births of neonates from 22 completed weeks of gestational age and stillborn neonates from 180 days onward (25 weeks 5 days). Whether a stillborn aged between 22 weeks and 25 weeks 5 days is registered depends on the parents' choice. Gynecologists complete the birth or death certificate, and parents are requested to declare the birth or death at the CBR within 15 days of delivery. District councils perform this registration at a local level, and socioeconomic data concerning the nationality of the mother, her birth nationality, and educational status are recorded.

For the present study, the SPE and the CBR data were used to facilitate an analysis of the association between immigration and pregnancy outcomes in Flanders. The mother's origin was defined on the basis of her nationality at birth, and immigrants were defined as women born in a country other than Belgium. An immigrant's country of origin was further classified according to income group as defined by the World Bank Atlas Method [10]: on the basis of gross national income per capita, a country's economy was categorized as low income (US \$1035 or less), middle income (US \$1036–\$12 615), or high income (US \$12 616 or more). This method considers the average income of a country's citizens and is a reflection of the social, economic, and environmental well-being of the country and its people.

For the study, fetal death was defined as a stillborn of at least 500 g at 22 or more weeks of gestation. Infant death was defined as the sum of early neonatal (death at 0–6 days), late neonatal (7–27 days), and post-neonatal (28–364 days) deaths. The educational level of the mother

was based on the highest degree or diploma obtained (none/primary, low secondary, high secondary, and tertiary).

Statistical analysis was carried out with the statistical software package R (R Foundation, Vienna, Austria). Univariate comparison of categorical variables was done with Pearson  $\chi^2$  test. Continuous variables were compared by Wilcoxon rank-sum test. Differences were considered statistically significant for a *P* value of less 0.05. Crude odds ratios (ORs) were calculated to compare data between the immigrant population and native-born mothers. The 95% confidence interval (95% CI) was calculated on the basis of the standard error. Adjusted ORs were calculated by using a logistic mixed model to take into account potential confounders (i.e. maternal age, self-reported maternal educational level attained, parity, and multiple pregnancies).

### 3. Results

During the study period, 328 969 neonates weighing at least 500 g were delivered. After discarding data with a missing maternal origin (0.8%), 326 178 deliveries remained. Another 12 births were excluded because of other missing data (maternal age, parity, or gestational age). As a result, the final analysis included data from 326 166 deliveries.

In total, 80.2% of women giving birth in Flanders during the study period were native-born (*n* = 261 566), whereas 19.8% were not Belgian-born and were defined as immigrant mothers (*n* = 64 600). The immigrant group was further categorized as originating from low-income (12.5%, *n* = 8066), middle-income (65.0%, *n* = 41 985), and high-income (22.5%, *n* = 14 549) countries.

Fig. 1 gives an overview of all countries with immigrants in Flanders according to this classification. Table 1 summarizes the relative weight of the relevant nations: only countries with at least 100 immigrant mothers have been included. In the high-income group, most mothers originated from the neighboring countries: 54% came from Flanders'

**Table 1**  
Number of deliveries by immigrant women classified by World Bank country income groups.

Income group	Countries (no. of deliveries) <sup>a</sup>
Low income	Afghanistan (275), Bangladesh (147), Burundi (122), Congo Dem. Rep. (1354), Ghana (688), Guinea (235), India (762), Nepal (162), Nigeria (696), Pakistan (621), Rwanda (250), Senegal (164), Somalia (174), Togo (106), Vietnam (146)
Middle income	Albania (222), Algeria (528), Angola (282), Armenia (398), Belarus (142), Herzegovina (162), Brazil (305), Bulgaria (563), Cameroon (275), Chile (120), China (664), Czech Republic (596), Dominican Republic (110), Ecuador (142), Hungary (130), Indonesia (174), Iran Islamic Rep. (259), Iraq (248), Kazakhstan (125), Lebanon (118), Macedonia FYR (185), Morocco (14 075), Philippines (692), Poland (1592), Romania (653), Russian Federation (1857), Serbia and Montenegro (2056), Syrian (286), Thailand (542), Tunisia (625), Turkey (9629), Ukraine (252)
High income	France (1598), Germany (697), Greece (182), Israel (190), Italy (1470), Japan (124), Netherlands (6273), Portugal (452), Spain (612), UK (674), USA (389)

<sup>a</sup> Only countries with 100 or more deliveries by immigrant mothers are listed.

**Table 2**  
Maternal characteristics in relation to maternal region of origin.<sup>a</sup>

Characteristic	Deliveries by native-born mothers (n = 261 566)	Deliveries by immigrant mothers			
		Overall (n = 64 600)	Low-income group (n = 8066)	Middle-income group (n = 41 985)	High-income group (n = 14 549)
Maternal age group					
<20 y	4249 (1.6)	2328 (3.6)	273 (3.4)	1804 (4.3)	251 (1.7)
20–34 y	223 409 (85.4)	51 614 (79.9)	6439 (79.8)	34 399 (81.9)	10 776 (74.1)
≥35 y	33 908 (13.0)	10 658 (16.5)	1354 (16.8)	5782 (13.8)	3522 (24.2)
Mean ± SD	29.7 ± 4.6	29.1 ± 5.6	29.3 ± 5.6	28.4 ± 5.6	31.0 ± 5.3
P value	Ref.	<0.001	<0.001	<0.001	<0.001
No of pregnancies					
Singleton	252 503 (96.5)	62 481 (96.7)	7778 (96.4)	40 740 (97.0)	13 963 (96.0)
Multiple	3.5 (9063)	3.3 (2119)	3.6 (288)	3.0 (1245)	4.0 (586)
P value	Ref.	0.022	0.631	<0.001	<0.001
Parity					
0	128 380 (49.1)	26 274 (40.7)	3029 (37.5)	16 798 (40.0)	6447 (44.3)
1–3	128 976 (49.3)	34 903 (54.0)	4573 (56.7)	22 751 (54.2)	7579 (52.1)
≥4	4210 (1.6)	3423 (5.3)	464 (5.8)	2436 (5.8)	523 (3.6)
Mean ± SD	1.75 ± 0.97	2.10 ± 1.31	2.17 ± 1.28	2.14 ± 1.34	1.94 ± 1.24
P value	Ref.	<0.001	<0.001	<0.001	<0.001
Maternal education					
None/primary	11 024 (4.2)	19 997 (31.0)	3839 (47.6)	14 704 (35.0)	1454 (10.0)
Low secondary	17 024 (6.5)	9668 (15.0)	1254 (15.5)	7107 (17.0)	1307 (9.0)
High secondary	102 657 (39.3)	23 017 (35.6)	1844 (22.9)	14 830 (35.3)	6343 (43.6)
Tertiary	130 861 (50.0)	11 918 (18.4)	1129 (14.0)	5344 (12.7)	5445 (37.4)
P value	Ref.	<0.001	<0.001	<0.001	<0.001

<sup>a</sup> Values are given as number (percentage) or mean ± SD. Where possible, P values are calculated for mean ± SD.

closest neighbors, Netherlands (n = 6273) and France (n = 1598). In the middle-income group, 56% (n = 23 704) came from Morocco or Turkey—2 countries with a 6-decade history of immigration into Flanders. The low-income group consisted mainly of central African countries (especially Congo), India, and Pakistan. According to the SPE and CBR data, 72.4% of native mothers and 27.6% of immigrant mothers delivered in university hospitals, compared with 79.5% and 20.5%, respectively, in non-university hospitals.

Table 2 shows the distribution of maternal characteristics for native-born and immigrant mothers. On average, compared with the native group, mothers from the immigrant group were more likely to be younger than 20 years (3.6% versus 1.6%) and older than 34 years (16.5% versus 13.0%). They were also more likely to be multipara (54.0% versus 49.3%) and grand multipara (5.3% versus 1.6%), and percentages were highest for the low- and middle-income groups. There was a relationship between the income group and the level of maternal education:

**Table 3**  
Obstetric characteristics in relation to maternal region of origin.<sup>a</sup>

Characteristic	Deliveries by native-born mothers (n = 261 566)	Deliveries by immigrant mothers			
		Overall (n = 64 600)	Low-income group (n = 8066)	Middle-income group (n = 41 985)	High-income group (n = 14 549)
Mode of labor onset					
Induced	70 598 (27.0)	14666 (22.7)	1720 (21.3)	9359 (22.3)	3587 (24.7)
Spontaneous	190 968 (73.0)	49 934 (77.3)	6346 (78.7)	32 626 (77.7)	10 962 (75.3)
P value	Ref.	<0.001	<0.001	<0.001	<0.001
Mode of delivery					
Vaginal	182 772 (70.0)	45 014 (69.9)	4992 (62.1)	30 019 (71.7)	10 003 (69.0)
Instrumental	27 361 (10.5)	6192 (9.6)	720 (8.9)	4046 (9.7)	1426 (9.8)
Planned cesarean	30 260 (11.6)	7368 (11.4)	1297 (16.1)	4287 (10.2)	1784 (12.3)
Emergency cesarean	20 492 (7.9)	5838 (9.1)	1034 (12.9)	3515 (8.4)	1289 (8.9)
P value	Ref.	<0.001	<0.001	<0.001	<0.001
Gestational age, weeks					
22–27	735 (0.3)	254 (0.4)	41 (0.5)	158 (0.4)	55 (0.4)
28–31	1832 (0.7)	570 (0.9)	82 (1.0)	322 (0.7)	166 (1.1)
32–36	18 774 (7.2)	4121 (6.4)	573 (7.1)	2509 (6.0)	1039 (7.2)
≥37	240 225 (91.8)	59 655 (92.3)	7370 (91.4)	38 996 (92.9)	13 289 (91.3)
Mean ± SD	38.8 ± 1.9	38.9 ± 2.0	38.7 ± 2.1	38.9 ± 1.9	38.8 ± 2.0
P value	Ref.	<0.001	0.135	<0.001	<0.001
Birth weight, g					
500–1499	2398 (0.9)	768 (1.2)	141 (1.8)	436 (1.0)	191 (1.3)
1500–2499	15 159 (5.8)	3472 (5.4)	559 (6.9)	2016 (4.8)	897 (6.2)
≥2500	244 009 (93.3)	60 360 (93.4)	7366 (91.3)	39 533 (94.2)	13 461 (92.5)
Mean ± SD	3305 ± 555	3314 ± 570	3220 ± 594	3337 ± 559	3302 ± 582
P value	Ref.	<0.001	<0.001	<0.001	0.891
Apgar at 5 min					
<7	4145 (1.6)	1329 (2.1)	245 (3.1)	827 (2.0)	257 (1.8)
P value	Ref.	<0.001	<0.001	<0.001	0.096

<sup>a</sup> Values are given as number (percentage) or mean ± SD. Where possible (for continuous variables), P values are calculated for mean ± SD.

**Table 4**  
Fetal, neonatal, and infant mortality rates in relation to maternal region of origin.<sup>a</sup>

Mortality	Deaths among native-born mothers (n = 261 566 deliveries)	Deaths among immigrant mothers			
		Overall (n = 64 600 deliveries)	Low-income group (n = 8066 deliveries)	Middle-income group (n = 41 985 deliveries)	High-income group (n = 14 549 deliveries)
Fetal	618 (2.4)	229 (3.5)	52 (6.5)	145 (3.5)	32 (2.2)
P value	Ref.	<0.001	<0.001	<0.001	0.758
Early neonatal	412 (1.6)	160 (2.5)	21 (2.6)	99 (2.4)	40 (2.8)
P value	Ref.	<0.001	0.032	<0.001	<0.001
Late neonatal	154 (0.6)	50 (0.8)	7 (0.9)	30 (0.7)	13 (0.9)
P value	Ref.	0.107	0.482	0.382	0.199
Post-neonatal	310 (1.2)	107 (1.7)	19 (2.4)	73 (1.8)	15 (1.0)
P value	Ref.	0.003	0.005	0.004	0.690
Infant	876 (3.4)	317 (4.9)	47 (5.9)	202 (4.8)	68 (4.7)
P value	Ref.	<0.001	<0.001	<0.001	0.010

<sup>a</sup> Values are given as number (%). P values for fetal/infant death rates among immigrant mothers (also from the low-, middle-, and high-income group) are compared with the death rate of the native-born mothers.

the lower the level of source region income, the higher the rate of women with no or primary level education and the lower the rate of women with high secondary level education.

Table 3 shows the obstetric characteristics of the women. Labor induction was significantly more frequent among native mothers (27.0%) than among immigrant mothers (22.7%); the lowest rate was observed for the low-income group of immigrants. There was a significantly lower incidence of normal vaginal deliveries (62.1% versus 70.0%), and a higher incidence of pre-labor (16.1% and 11.6%) and emergency (12.9% versus 7.9%) cesarean deliveries in the low-income immigrant group compared with native mothers ( $P < 0.001$ ). Preterm birth and a birth weight under 2500 g occurred more often among native women; however, extremely low birth weight ( $< 1500$  g) was significantly more frequent in the immigrant population than in the native population (1.2% versus 0.9%, respectively). The latter observation was mainly due to the frequency of newborns under 1500 g, which was twice as high among low-income immigrants as among native mothers. An Apgar score of less than 7 at 5 minutes was more frequently seen among immigrants, especially those in the low-income group.

There were 2049 deaths registered: 847 fetal, 572 early neonatal, 204 late neonatal, and 417 post-neonatal deaths. Unfortunately, for 390 fetal deaths (31%), data on the maternal country of origin and educational level were “missing.” These deaths were reported through the SPE, but were not registered at the Belgian CBR. Most probably, extremely premature infants were registered by the SPE (because they were  $> 500$  g), but not by the CBR (because they were  $< 180$  gestational days).

Table 4 shows the fetal, neonatal, and infant death rates. In univariate analysis, there was a significantly higher death rate among immigrant mothers than among native mothers. The fetal death rate was

inversely related to the source region income of the mother: the lower the World Bank ranking of the country, the higher the fetal death rate. There was no significant difference in the late neonatal mortality between native women and immigrants. The post-neonatal death rate showed an inverse relationship with country of origin: the higher the source region income, the lower the mortality rate.

Table 5 reports the ORs for the fetal and infant mortality risk for immigrants with respect to Belgian-born women. All outcomes in the univariate analysis, except for late neonatal mortality, indicated a significant disadvantage for immigrants in Flanders and more so for the low-income group. After adjustment for maternal age, parity, multiple pregnancy, and maternal level of education, however, almost all of the differences became non-significant. Only the early neonatal death rate remained significantly higher for the immigrants compared with native-born mothers (adjusted OR, 1.30; 95% CI, 1.06–1.60). In addition, the fetal death rate became lower among immigrant mothers than among native women (adjusted OR, 0.67; 95% CI, 0.57–0.80).

#### 4. Discussion

In Flanders, a highly urbanized region with compulsory health insurance covering maternity care for all inhabitants, fetal and infant mortality rates were found to be significantly higher among immigrant mothers than among native-born mothers. Within the immigrant group, mothers originating from low-income countries, as defined by the World Bank Atlas method, seemed to carry the highest burden with a crude OR of 2.74 (95% CI, 2.02–3.64) for fetal mortality and 1.75 (95% CI, 1.30–2.35) for infant mortality compared with native-born mothers.

**Table 5**  
Effect of maternal region of origin on fetal, neonatal, and infant mortality rates.

Analysis	Odds ratio (95% confidence interval)			
	All immigrants	Low-income group	Middle-income group	High-income group
Univariate <sup>a</sup>				
Fetal death	1.50 (1.29–1.75)	2.74 (2.02–3.64)	1.46 (1.21–1.76)	0.93 (0.63–1.33)
Early neonatal death	1.58 (1.31–1.89)	1.66 (1.02–2.58)	1.50 (1.19–1.87)	1.75 (1.23–2.42)
Late neonatal death	1.32 (0.96–1.81)	1.48 (0.59–3.13)	1.22 (0.79–1.81)	1.52 (0.79–2.68)
Post-neonatal death	1.40 (1.12–1.75)	2.00 (1.19–3.18)	1.47 (1.12–1.90)	0.87 (0.48–1.46)
Infant	1.47 (1.29–1.67)	1.75 (1.3–2.35)	1.44 (1.24–1.68)	1.40 (1.09–1.79)
Multivariate <sup>b</sup>				
Fetal death	0.67 (0.57–0.80)	0.93 (0.68–1.28)	0.69 (0.60–0.80)	0.77 (0.60–1.00)
Early neonatal death	1.30 (1.06–1.60)	1.06 (0.66–1.71)	1.14 (0.96–1.36)	1.36 (1.08–1.72)
Late neonatal death	1.25 (0.88–1.78)	1.45 (0.64–3.27)	1.07 (0.79–1.46)	1.29 (0.86–2.93)
Post-neonatal death	0.97 (0.76–1.24)	1.39 (0.84–2.30)	0.96 (0.78–1.17)	0.81 (0.56–1.18)
Infant death	1.17 (1.01–1.35)	1.23 (0.90–1.70)	1.06 (0.94–1.20)	1.16 (0.97–1.39)

<sup>a</sup> Crude odds ratio.

<sup>b</sup> Adjusted odds ratio; adjusted for maternal age, parity, multiple pregnancy, and maternal level of education.



These crude results are in line with other European studies showing higher rates of perinatal and infant mortality among immigrant mothers than among native mothers in Netherlands [11], Denmark [12], Finland [13], and Germany [8]. In a systematic review on perinatal health outcomes among migrants in high-resource industrialized countries, by contrast, the mortality risk among infants born to migrants was not found to be consistently higher, but was found to be the highest among refugees, non-European migrants to Europe, and foreign-born black mothers in the USA [3]. When the data were analyzed according to the constitution of different World Bank income groups, the present study found similar results. The low-income group consisted mainly of mothers who had recently immigrated from regions of conflict (especially central Africa), and in univariate analysis showed the highest rate of fetal/infant mortality compared with native mothers. In the high-income group, which mostly comprised mothers originating from bordering countries (Netherlands and France) and the European Union, fetal mortality was not significantly higher compared with the Belgian-born group (crude OR, 0.93; 95% CI, 0.63–1.33).

The most pronounced differences between native and immigrant mothers were found in the fetal and early neonatal mortality rates; by contrast, late neonatal mortality did not differ significantly between native women and immigrant women in any of the income groups (crude OR, 1.32; 95% CI, 0.96–1.81). Whereas fetal and early neonatal mortality rely on a healthy pregnancy environment, late neonatal mortality is more dependent on the neonatal intensive care that is available. Early neonatal mortality might still be due to the delivery (e.g. extreme prematurity); however, once under the control of neonatologists, discrepancies in outcome become less obvious. In terms of post-neonatal mortality, medical care also has a lower impact, whereas adverse maternal factors (e.g. smoking, being unemployed, or low socioeconomic status) may again affect the infant.

In the present multivariate analysis, however, most of the differences became non-significant. Health differences are tied to socioeconomic resources, and many health discrepancies disappear when socioeconomic status is considered. Maternal education is often used as a secondary proxy for socio-economic level [14]. A previous study conducted in Flanders found that fetal death was 4 times more frequent among native mothers with the lowest educational background compared with those with the highest educational attainment [15]. The present study found a relationship between the income group and the level of maternal education: the lower the level of source region income, the higher the rate of no or primary education. After adjustment for educational level alone, the difference in fetal/infant mortality became non-significant, indicating the important influence of socioeconomic deprivation. In the multivariate analysis, only the early neonatal mortality remained significantly higher, and fetal mortality became significantly lower among the immigrant group (adjusted OR, 0.67; 95% CI, 0.57–0.80). Regarding the maternal country of origin, the latter association was significant only for the middle-income group of countries (adjusted OR, 0.69; 95% CI, 0.60–0.80). As mentioned above, 56% of this group comprised Maghreb immigrants from Turkey and Morocco. Although we do not have supporting data, the lifestyle habits of this population are usually better (they smoke and drink less), and most women work as housewives. Furthermore, these nations have a 6-decade history of immigration into Flanders. Therefore, it is not unexpected that, after adjusting for variables such as education, these women have better fetal health outcomes. A previous study in Belgium comparing birth weight differences and preterm deliveries between Maghreb immigrants and native women found similar results; that is, a better outcome for the North African immigrants [14].

Increased rates of preterm birth and thus of adverse neonatal outcomes have been reported for some migrant groups [15]; however, the data are inconsistent [5]. According to a study in Brussels, the higher perinatal mortality observed among women originating from Sub-Saharan Africa reflected mainly a high percentage of preterm deliveries and low birth weight, in addition to a low socioeconomic level [16]. In

the present study, there were no notable differences in preterm birth between immigrant and native mothers with the exception of extremely low birth weight (<1500 g), which was significantly more common in the immigrant group mainly owing to the high percentage of extremely low birth weight among lower-income countries (mostly representing central Africa). The differences in an Apgar score of less than 7 at 5 minutes (Table 2) might be a reflection of the differences in the extreme low birth weight incidence according to the source region income.

There was a significantly lower rate of labor induction among immigrant mothers (22.7%), particularly in the lower-income group (21.3%), than among native-born mothers (27%). This might be related to more difficult patient–physician communication in the immigrant group. Furthermore, there was a higher incidence of cesarean deliveries among migrants belonging to the low-income group. This result is in line with a recent meta-analysis concerning international migration and cesarean delivery showing that certain groups of international migrants (e.g. Sub-Saharan Africans) consistently have different rates of cesarean delivery compared with women born in the receiving country [17]. Evidence to explain these differences is limited. In a recent study in Belgium into the effect of immigration status on cesarean delivery, Minsart et al. [18] found that global rates of cesarean delivery currently vary among Robson categories in immigrant subgroups. They found an increased global risk for cesarean among women of Sub-Saharan origin compared with Belgian natives (adjusted OR, 2.06; 95% CI, 1.62–2.63), and those with a term singleton newborn in cephalic position, without a previous cesarean delivery, were found to carry the highest burden (adjusted OR, 3.19; 95% CI, 1.71–5.96).

The present study has several shortcomings. First, there was a lack of information on risk factors such as hypertension, diabetes, previous obstetric history, and high body mass index, and on lifestyle factors including smoking and alcohol use. The latter indices of poor health are potential confounders that might differ among the study groups and might account for a significantly worse perinatal health outcome. Second, there were no data on the causes of fetal (prepartum versus intrapartum) and infant mortality, and as such no comparison of causes could be made between immigrant and native-born mothers. In previous studies, higher infant mortality among migrants was linked to a higher frequency of congenital malformations, particularly among newborns of Turkish, Pakistani, Somali, and Moroccan migrants in the Netherlands [19] and Denmark [12], and among Pakistani or Bangladeshi migrants in England and Wales [11]. This might be due to a higher incidence of consanguinity among immigrants [20], different attitudes toward prenatal screening, and a reluctance to terminate pregnancy when a diagnosis of malformation is made. Third, there was no information either on the duration of residence in Flanders or on measures of the degree of integration such as fluency in the Dutch language, which is predominant in Flanders. A systematic review by Bollini et al. [9] has shown that the risk of perinatal mortality is significantly reduced in countries with a strong integration policy including Belgium. By comparing perinatal mortality rates among immigrant mothers according to citizenship status, a recent study in Belgium [21] revealed that the naturalization status of immigrants was associated with a decreased risk of perinatal mortality. Naturalized immigrant mothers had a lower incidence of perinatal mortality (6.1‰) compared with their non-naturalized counterparts (10.3‰) with an adjusted OR of 2.2 (95% CI, 1.1–4.5). Last, there was no information on the timing of the first prenatal visit or the number of prenatal visits. A study in Flanders found that migrant women tend to begin prenatal visits later in their pregnancy [22]. They also make fewer visits compared with non-migrant women [23], and have a higher risk of inadequate care [24].

In conclusion, despite equality in access to perinatal care facilities, immigrant mothers, in particular those originating from low-income regions, had higher rates of fetal, neonatal, and infant death compared with native Flemish women. When adjusted for factors affecting fetal, neonatal, and infant health outcome (especially socioeconomic status), however, the differences became non-significant.

## Conflict of interest

The authors have no conflicts of interest.

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